IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicant(s): Suhail S. Saquib
Filed : July 31, 2000
Title : ALIASING ARTIFACT ATTENUATION SYSTEM
TC/A.U. : 2623
Examiner : A.P. Bhatnagar

Docket No. : 8445
Customer No.: 20349

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

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Sir:

This is an appeal from the final rejection of claims 1 - 49 of the application as set forth in the Office Action, made final, mailed April 21, 2004.

REAL PARTY IN INTEREST

The real party in interest in this appeal is Polaroid Corporation, a corporation organized and existing under the laws of the State of Delaware, of 1265 Main Street, Waltham, MA 02451.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

STATUS OF CLAIMS

1. Claims 1 - 49, all the claims in the application, have been rejected as being unpatentable over the references applied in support of the rejections.

STATUS OF AMENDMENTS

The Amendment After Final which was filed October 21, 2004 has not been entered.

In the Advisory action mailed November 22, 2004 it was stated that the amendment was not entered because the amended claims included new limitations which require a further search.

Appellant does not agree that the amended claims included new limitations which would require a new search. The amended claims were filed in an attempt to expressly recite features which are in fact reflected in the claims now on appeal.

In the Office action, made final, mailed April 21, 2004, the examiner, in response to the arguments made by applicant in the previously filed paper, stated at page 2:

> In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., "for selective attenuation of corruption in a digital signal",) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns,* 988 F.2d 1181, 26 USPQ 2d 1057 (Fed. Cir. 1993).

The examiner, at page 3, also stated:

> In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted the features upon which applicant relies, (i.e., "non-linear median filter",) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read

into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ 2d 1057 (Fed. Cir. 1993).

In response to these arguments, in the Amendment after Final, applicant amended the independent claims to recite expressly these features which are in fact reflected in the claims as originally filed. The amendment has not been entered.

Appellant therefore elects to prosecute this appeal on the basis of the claims which were in the application prior to the Final Office Action.

SUMMARY OF INVENTION

Appellant's claims are directed to a method and apparatus for selective attenuation, or removal, of corruption, or aliasing artifacts, in a digital signal. Corruption can be introduced into a digital signal by the phenomenon known as "aliasing". For a discussion of this phenomenon see page 4, lines 21 -25 of the application. In particular, appellant's method is designed to attenuate aliasing artifacts that occur in digital images captured with a sensor that does not have a suitable anti-aliasing filter. See the discussion extending from page 5, line 12 to page 6, line 5. In appellant's method the output signal is devoid of any aliasing artifacts which were already present in the input signal.

In the method of appellant the resolution of the digital input signal is first reduced to provide a

reduced resolution signal that has fewer data samples, or points, than the input signal. The reduced resolution signal is then median filtered, i.e., for any one sample in the reduced resolution signal the median filter computes the median of its neighboring *n* samples and replaces the sample value with the median value, to provide a filtered reduced resolution signal. The filtered reduced resolution signal is then interpolated, that is, the number of data points is increased, to provide the digital output signal.

The process of decimation and interpolation reduces the computational complexity involved in the claimed method. See, for example, the discussion on page 17, lines 3 - 14.

REFERENCES APPLIED BY EXAMINER

1. U.S. Patent No. 5,528,301 ("Hau et al").
2. U.S. Patent No. 5,831,677 ("Streater et al").
3. U.S. Patent No. 5,841,480 ("Rhodes").
4. U.S. Patent No. 5,844,617 ("Faroudja et al").
5. U.S. Patent No. 6,519,288 ("Vetro et al").

DISCUSSION OF THE REFERENCES

1. Hau et al is directed to a method for video conversion from one format into another. In contrast to appellant's method, the method of Hau et al is primarily concerned with not introducing aliasing artifacts in the conversion process rather than eliminating pre-existing aliasing artifacts.

2. Streater et al is directed to a method for capturing and compressing video images in real time.

3. Rhodes teaches a method for converting a digital signal to luminance space.

4. Faroudja et al relates to television signal processing and to signal processing apparatus and methods for enhancing the vertical resolution of a television signal.

5. Vetro et al describes an apparatus for decoding a digital signal and generating a low resolution version of the signal.

ISSUES

A. Whether the subject matter of claims 1, 2, 11, 12, 20, 21, 35 and 36 is unpatentable under 35 USC § 102(b) as being anticipated by Hau et al.

B. Whether the subject matter of claims 3, 22 and 37 is unpatentable under 35 USC § 103(a) over Hau et al in view of Vetro et al.

C. Whether the subject matter of claims 4, 23 and 38 is unpatentable under 35 USC § 103(a) over Hau et al in view of Vetro et al and Streater et al.

D. Whether the subject matter of claims 5, 6, 24, 25, 39 and 40 is unpatentable under 35 USC § 103(a) over Hau et al in view of Faroudja et al.

E. Whether the subject matter of claims 7 - 10, 26 -29 and 41 - 44 is unpatentable under 35 USC § 103(a) over Hau et al in view of Vetro et al and Faroudja et al.

F. Whether the subject matter of claims 13 - 19, 30 -34 and 45 - 49 is unpatentable under 35 USC § 103(a) over Rhodes and Hau et al.

GROUPING OF CLAIMS

Pursuant to 37 CFR 1.192(c)(7), appellant requests that all the claims on appeal be considered as a single group.

ARGUMENT

I. The Art Rejections

Summary.

Hau et al does not teach each and every element of the invention recited in claims 1, 2, 11, 12, 20, 21, 35 and 36.

There is no suggestion or incentive to be found in the references cited to support the obviousness rejections which would place one skilled in the art in possession of the claimed subject matter as is required to properly support the rejections under 35 U.S.C. § 103(a).

Issue (a).

The purpose of appellant's method and apparatus is very different from that of Hau et al. The reference does not teach each and every limitation of the subject matter recited in claims 1, 2, 11, 12, 20, 21, 35 and 36.

As described previously, appellant's invention is directed to a method and apparatus for selective attenuation of corruption in a digital signal. Corruption can be introduced into a digital signal by the phenomenon known as "aliasing". For a discussion of this phenomenon see page 4, lines 21 -25 of the

application. In particular, appellant's method is designed to attenuate aliasing artifacts that occur in digital images captured with a sensor that does not have a suitable anti-aliasing filter. See the discussion extending from page 5, line 12 to page 6, line 5. In appellant's method the output signal is devoid of any aliasing artifacts which were already present in the input signal.

In the method of appellant the resolution of the digital input signal is first reduced to provide a reduced resolution signal that has fewer data samples, or points, than the input signal. The reduced resolution signal is then median filtered, i.e., for any one sample in the reduced resolution signal the median filter computes the median of its neighboring *n* samples and replaces the sample value with the median value, to provide a filtered reduced resolution signal. The filtered reduced resolution signal is then interpolated, that is, the number of data points is increased, to provide the digital output signal. It is important to note that the digital output signal includes all the frequencies of the digital input signal.

The process of decimation and interpolation reduces the computational complexity involved in the claimed method. See, for example, the discussion on page 17, lines 3 - 14 of the present specification.

The method of Hau et al is aimed at video conversion from one format into another which is very different from the method of appellant. In contrast to

appellant's method, the method of Hau et al is primarily concerned with not introducing aliasing artifacts in the conversion process rather than eliminating pre-existing aliasing artifacts.

The bandlimiting filter used in the Hau et al method is used when reducing the sampling rate from the input format to the output format. The role of the bandlimiting filter is to remove any high frequencies that are present in the input signal and that can not be represented in the lower sampling rate of the output filter. To achieve this result, the bandlimiting filter is necessarily a linear filter since all frequencies outside the cutoff range have to be attenuated by this filter independent of the nature of the input signal. In particular, Hau et al teaches using a finite impulse response ("FIR") filter for this purpose. See column 6, lines 20-24.

The linear bandlimiting filter used by Hau et al is quite unlike the median filter utilized by applicant. A median filter is a non-linear filter. The non-linearity of the median filter precludes the analysis of this type of filter in the frequency domain. The median filter switches its behavior depending on the input signal. For instance, if a median filter is presented with a step-edge, as illustrated in Fig. 10 of the present application, the output signal is also a step-edge with no degradation. Since, according to the method of appellant, all the frequencies in the input signal are reproduced in the output signal the median

filter in this case is not acting as a bandlimiting filter and can not be considered as such for the purpose of asserting that the Hau et al reference supports an anticipation rejection of the claims.

It must be recognized that the method of Hau et al could not achieve its desired result of anti-aliasing (see, column 3, lines 41-46) if a median filter were to be substituted for the specified bandlimiting filter since the median filter would not attenuate the high frequencies in some cases thus leading to aliasing in the output signal. Conversely, if a linear bandlimiting filter were to be substituted for the required median filter in the method and apparatus of appellant, the desired result of attenuating aliasing artifacts in the input signal without degrading the original signal could not be achieved since frequencies outside the cutoff range would be attenuated.

Claim Interpretation.

The claims, when read in the light of the specification, include the features by which appellant's method, apparatus and multi-resolution filter distinguish from the reference. With respect to selective attenuation of corruption in a digital signal, this result is obtained by the method of the invention. The method claims recite a sequence of steps, including the step of median filtering a reduced resolution signal, to produce a digital output signal which is

devoid of any aliasing artifacts which were present in the digital input signal. The result obtained according to the method is clearly described in the specification and those skilled in the art would recognize that the claimed sequence of steps provides the result taught by the specification.

The apparatus claims (see claims 35 and 36 for example) recite median filtering means and the multi-resolution filter claims (see claims 20 and 21 for example) recite a median filter. It is well known in the art that median filters are non-linear filters. Since the method, apparatus and multi-resolution filter claims specifically recite, respectively, a median filtering step, median filtering means and a median filter, it is beyond dispute that the median filter specifically recited is a non-linear filter even though the specific term "non-linear" is not present.

As pointed by the examiner, claims are to be interpreted in light of the specification See *In re Van Geuns, supra*. Here, when the claims are interpreted in this manner it is clearly apparent that the claimed method, apparatus and multi-resolution filter are for the purpose of selectively attenuating, or removing, corruption, or aliasing artifacts, present in a digital input signal.

For the foregoing reasons the subject matter of claims 1, 2, 11, 12, 20, 21, 35 and 36 is not anticipated by Hau et al.

Issue (b).

The subject matter of claims 3, 22 and 37 is patentably distinguishable over Hau et al in view of Vetro et al.

These claims are each dependent upon a claim discussed above with respect to the Hau et al and are directed to an embodiment of the invention wherein the reducing of the resolution of the digital input signal involves linear low pass filtering of the signal. It has been shown that the primary reference does not teach or in any way suggest the advantageous method, apparatus or multi-resolution filter of applicant.

The disclosure of Vetro et al does not render the rejection any more effective. Vetro et al describes an apparatus for decoding a digital signal and generating a low resolution version of the signal. As is the case with Hau et al, the secondary reference is not directed to removing aliasing artifacts from a digital input signal. Those skilled in the art and knowing of the disclosures of these references would not be placed in possession of the presently claimed subject matter.

For these reasons the subject matter of claims 3, 22 and 37 is not obvious within the meaning of 35 USC § 103.

Issue (c).

The subject matter of claims 4, 23 and 38 is patentably distinguishable over Hau et al in view of Vetro et al and Streater et al.

These claims are each dependent upon a claim discussed above with respect to the primary reference and are directed to an embodiment of the invention wherein the reducing of the resolution of the digital input signal involves mean filtering of the digital input signal. It has been shown above that Hau et al and Vetro et al, viewed individually or together, do not teach or in any way suggest the advantageous method, apparatus or multi-resolution filter of applicant.

The disclosure of Streater et al does not render the rejection any more effective. As is the case with Hau et al and Vetro et al, Streater et al is not directed to removing aliasing artifacts from a digital input signal. Streater et al is directed to a method for capturing and compressing video images in real time. Those skilled in the art and knowing of the disclosures of these references would not be placed in possession of the subject matter recited in claims 4, 23 and 38.

For these reasons the subject matter of claims 4, 23 and 38 is not obvious within the meaning of 35 USC § 103.

Issue (d).

The subject matter of claims 5, 6, 24, 25, 39 and 40 is patentably distinguishable over Hau et al in view of Faroudja et al.

These claims are each dependent upon a claim discussed in detail above with respect to the primary reference and are directed to embodiments of the invention wherein the interpolation step is carried out in a particular manner. It has been shown above that Hau et al does not teach or in any way suggest the advantageous method, apparatus or multi-resolution filter of applicant.

The disclosure of Faroudja et al does not render the rejection any more effective. As is the case with the other references discussed above, Faroudja et al is not directed to removing aliasing artifacts from a digital input signal. Faroudja et al relates to television signal processing and more particularly to signal processing apparatus and methods for enhancing the vertical resolution of a television signal. Those skilled in the art and knowing of the disclosures of these references would not be placed in possession of the presently claimed subject matter.

For these reasons the subject matter of claims 5, 6, 24, 25, 39 and 40 is not obvious within the meaning of 35 USC § 103.

Issue (e).

The subject matter of claims 7 - 10, 26 -29 and 41 - 44 is patentably distinguishable over Hau et al in view of Vetro et al and Faroudja et al.

These claims are directed to particular embodiments of appellant's invention. These embodiments involve median filtering a reduced resolution signal in a particular manner. It has been shown above that these references do not teach or in any way suggest the advantageous method, apparatus or multi-resolution filter of applicant.

It has been shown previously that appellant's invention is designed to attenuate aliasing artifacts that occur in digital images and that the disclosures of Hau et al, Vetro et al and Faroudja et al do not teach or suggest appellant's method, apparatus and filter. Those skilled in the art and knowing of the disclosures of these references would not be placed in possession of the presently claimed subject matter.

For these reasons the subject matter of claims 7 - 10, 26 - 29 and 41 - 44 is not obvious within the meaning of 35 USC § 103.

Issue (f).

The subject matter of claims 13 - 19, 30 -34 and 45 - 49 is patentably distinguishable over Rhodes and Hau et al.

These claims are directed to embodiments of the invention wherein a second digital signal is produced from a first digital signal which includes a first luminance signal, a first chrominance signal and a second chrominance signal. The first and second chrominance signals are each filtered according to the method of claim 1 to produce, respectively, first and second filtered chrominance signals.

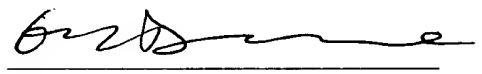
It has been shown above that Hau et al does not teach or in any way suggest the advantageous method, recited in claim 1. Rhodes, does teach the conversion of a digital signal to luminance space but, as is the case with Hau et al, does not teach or suggest removing aliasing artifacts from a digital signal. Those skilled in the art and knowing of the disclosures of these references would not be placed in possession of the presently claimed subject matter.

For these reasons the subject matter of claims 13 - 19, 30 -34 and 45 - 49 is not obvious within the meaning of 35 USC § 103.

CONCLUSION

For all of the foregoing reasons the 35 USC §§ 102 and 103 rejections should be reversed and claims 1 - 49 allowed.

Respectfully submitted,



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APPENDIX

Claims On Appeal

Claim 1: A method for filtering a digital input signal to produce a digital output signal, the method comprising steps of:

(A) reducing a resolution of the digital input signal to produce a reduced resolution signal;

(B) performing median filtering on the reduced resolution signal to produce a filtered reduced resolution signal; and

(C) performing interpolation on the filtered reduced resolution signal to produce the digital output signal.

Claim 2: The method of claim 1, wherein the step (A) comprises steps of:

(A)(1) performing linear filtering on the digital input signal to produce a filtered digital input signal; and

(A)(2) down-sampling the filtered digital input signal to produce the reduced resolution signal.

Claim 3: The method of claim 2, wherein the step (A)(1) comprises a step of performing linear low-pass filtering on the digital input signal.

Claim 4: The method of claim 3, wherein the step of performing linear low-pass filtering on the digital input signal comprises a step of performing mean filtering on the digital input signal.

Claim 5: The method of claim 1, wherein the step (C) comprises steps of:

(C)(1) up-sampling the filtered reduced resolution signal to produce an up-sampled filtered signal; and

(C)(2) performing linear low-pass filtering on the up-sampled filtered signal to produce the digital output signal.

Claim 6: The method of claim 5, wherein the step (C)(2) comprises a step of performing low-pass filtering using a linear low-pass filter for use in bi-cubic interpolation to produce the digital output signal.

Claim 7: A method for filtering a digital input signal to produce a digital output signal, the method comprising steps of:

(A) performing linear filtering on the digital input signal to produce a filtered digital input signal;

(B) down-sampling the filtered digital input signal to produce a reduced resolution signal;

(C) performing median filtering on the reduced resolution signal to produce a filtered reduced resolution signal;

(D) up-sampling the filtered reduced resolution signal to produce an up-sampled filtered signal; and

(E) performing low-pass linear filtering on the up-sampled filtered signal to produce the digital output signal.

Claim 8: The method of claim 7, wherein the step (B) comprises a step of:

(B)(1) down-sampling the filtered digital input signal by a down-sampling factor to produce the reduced resolution signal;

wherein the step (D) comprises a step of:

(D)(1) up-sampling the filtered reduced resolution signal by an up-sampling factor to produce the up-sampled filtered signal; and

wherein the up-sampling factor and the down-sampling factor are equal.

Claim 9: The method of claim 8, wherein the step (A) comprises a step of:

(A) performing linear filtering with a rectangular impulse response of length *dec* on the digital input signal to produce the filtered digital input signal; and

wherein *dec* is equal to the down-sampling factor and to the up-sampling factor.

Claim 10: The method of claim 9, wherein the step (E) comprises a step of:

(E)(1) performing low-pass linear filtering with a support of length *dec* on the up-sampled filtered signal to produce the digital output signal.

Claim 11: The method of claim 1, wherein the digital input signal comprises a signal corresponding to a chrominance channel of a digital image.

Claim 12: The method of claim 1, wherein the digital input signal comprises a two-dimensional signal.

Claim 13: A method for producing a second digital image from a first digital image, the first digital image including a luminance signal, a first chrominance signal, and a second chrominance signal, the second digital image including the luminance signal, a first filtered chrominance signal, and a second filtered chrominance signal, the method comprising steps of:

(A) filtering the first chrominance signal of the first digital image according to the method of claim 1 to produce the first filtered chrominance signal; and

(B) filtering the second chrominance signal of the first digital image according to the method of claim 1 to produce the second filtered chrominance signal.

Claim 14: The method of claim 13, wherein the first digital image is encoded according to a first color space, and wherein the method further comprises a step of:

(C) converting a third digital image encoded according to a second color space into the first digital image.

Claim 15: The method of claim 14, wherein the first color space comprises a luminance-chrominance color space, and wherein the second color space comprises an RGB color space.

Claim 16: The method of claim 15, wherein the step (C) comprises steps of:

(C)(1) subtracting a green color signal of the third digital image from a red color signal of the third digital image to produce the first chrominance signal of the first digital image;

(C)(2) subtracting the green color signal of the third digital image from a blue color signal of the third digital image to produce the second chrominance signal of the first digital image; and

(C)(3) providing the green color signal as the luminance signal of the first digital image.

Claim 17: The method of claim 14, further comprising a step of:

(D) converting the second digital image into a fourth digital image encoded according to a third color space.

Claim 18: The method of claim 17, wherein the first color space comprises a luminance-chrominance color space, and wherein the third color space comprises an RGB color space.

Claim 19: The method of claim 18, wherein the step (D) comprises steps of:

(D)(1) adding the first filtered chrominance signal to the luminance signal to produce a red color signal of the fourth digital image;

(D)(2) adding the second filtered chrominance signal to the luminance signal to produce a blue color signal of the fourth digital image; and

(D)(3) providing the luminance signal as a green color signal of the fourth digital image.

Claim 20: A multi-resolution filter comprising:

a resolution reduction filter to produce a reduced resolution signal by reducing the resolution of a digital input signal;

a median filter to produce a filtered reduced resolution signal by filtering the reduced resolution signal; and

an interpolation filter to produce a digital output signal by interpolating the filtered reduced resolution signal.

Claim 21: The multi-resolution filter of claim 20, wherein the resolution reduction filter comprises:

a linear filter to produce a filtered digital input signal by filtering the digital input signal; and

a down-sampler to produce the reduced resolution signal by down-sampling the filtered digital input signal.

Claim 22: The multi-resolution filter of claim 21, wherein the linear filter comprises a linear low-pass filter.

Claim 23: The multi-resolution filter of claim 22, wherein the linear low-pass filter comprises a mean filter.

Claim 24: The multi-resolution filter of claim 20, wherein the interpolation filter comprises:

an up-sampler to produce an up-sampled filtered signal by up-sampling the filtered reduced resolution signal; and

a linear low-pass filter to produce the digital output signal by filtering the up-sampled filtered signal.

Claim 25: The multi-resolution filter of claim 24, wherein the linear low-pass filter comprises a low-pass filter used in bi-cubic interpolation.

Claim 26: A multi-resolution filter for filtering a digital input signal to produce a digital output signal, the multi-resolution filter comprising:

a linear filter to produce a filtered digital input signal by filtering the digital input signal;

a down-sampler to produce the reduced resolution signal by down-sampling the filtered digital input signal;

a median filter to produce a filtered reduced resolution signal by filtering the reduced resolution signal;

an up-sampler to produce an up-sampled filtered signal by up-sampling the filtered reduced resolution signal; and

a linear low-pass filter to produce the digital output signal by filtering the up-sampled filtered signal.

Claim 27: The multi-resolution filter of claim 26, wherein the down-sampler has a down-sampling factor that is equal to an up-sampling factor of the up-sampler.

Claim 28: The multi-resolution filter of claim 27, wherein the linear filter has a support that is equal to the down-sampling factor and the up-sampling factor.

Claim 29: The multi-resolution filter of claim 28, wherein the linear low-pass filter has a support that is equal to the down-sampling factor and the up-sampling factor.

Claim 30: A multi-resolution filtering system for producing a second digital image from a first digital image, the first digital image including a luminance signal, a first chrominance signal, and a second chrominance signal, the second digital image including the luminance signal, a first filtered chrominance signal, and a second filtered chrominance signal, the multi-resolution filtering system comprising:

a first multi-resolution filter according to claim 20 to produce the first filtered chrominance signal by filtering the first chrominance signal of the first digital image; and

a second multi-resolution filter according to claim 20 to produce the second filtered chrominance signal by filtering the second chrominance signal of the first digital image.

Claim 31: The multi-resolution filtering system of claim 30, wherein the first digital image is encoded according to a first color space, and wherein the multi-resolution filtering system further comprises:

a first color converter to convert a third digital image encoded according to a second color space into the first digital image.

Claim 32: The multi-resolution filtering system of claim 31, wherein the first color converter comprises:

a first subtractor to develop the first chrominance signal by subtracting a green color signal of the third digital image from a red color signal of the third digital image; and

a second subtractor to develop the second chrominance signal by subtracting the green color signal of the third digital image from a blue color signal of the third digital image.

Claim 33: The multi-resolution filtering system of claim 31, further comprising:

a second color converter to convert the second digital image into a fourth digital image encoded according to a third color space.

Claim 34: The multi-resolution filtering system of claim 33, wherein the second color converter comprises:

a first adder to develop a red color signal of the fourth digital image by adding the first filtered chrominance signal to the luminance signal of the second digital image; and

a second adder to develop a blue color signal of the fourth digital image by adding the second filtered chrominance signal to the luminance signal of the second digital image.

Claim 35: An apparatus for filtering a digital input signal to produce a digital output signal, the apparatus comprising:

resolution reduction means for reducing a resolution of the digital input signal to produce a reduced resolution signal;

median filtering means for performing median filtering on the reduced resolution signal to produce a filtered reduced resolution signal; and

interpolation means for performing interpolation on the filtered reduced resolution signal to produce the digital output signal.

Claim 36: The apparatus of claim 35, wherein the resolution reduction means comprises:

means for performing linear filtering on the digital input signal to produce a filtered digital input signal; and

means for down-sampling the filtered digital input signal to produce the reduced resolution signal.

Claim 37: The apparatus of claim 36, wherein the means for performing linear filtering comprises means for performing linear low-pass filtering on the digital input signal.

Claim 38: The apparatus of claim 37, wherein the means for performing linear low-pass filtering comprises means for performing mean filtering on the digital input signal.

Claim 39: The apparatus of claim 35, wherein the interpolation means comprises:

up-sampling means for up-sampling the filtered reduced resolution signal to produce an up-sampled filtered signal; and

means for performing linear low-pass filtering on the up-sampled filtered signal to produce the digital output signal.

Claim 40: The apparatus of claim 39, wherein the means for performing linear low-pass filtering comprises means for performing low-pass filtering employed in bi-cubic interpolation on the up-sampled filtered signal to produce the digital output signal.

Claim 41: An apparatus for filtering a digital input signal to produce a digital output signal, the apparatus comprising steps of:

means for performing linear filtering on the digital input signal to produce a filtered digital input signal;

means for down-sampling the filtered digital input signal to produce a reduced resolution signal;

means for performing median filtering on the reduced resolution signal to produce a filtered reduced resolution signal;

means for up-sampling the filtered reduced resolution signal to produce an up-sampled filtered signal; and

means for performing low-pass linear filtering on the up-sampled filtered signal to produce the digital output signal.

Claim 42: The apparatus of claim 41, wherein the means for down-sampling comprises means for down-sampling the filtered digital input signal by a down-sampling factor to produce the reduced resolution signal, wherein the means for up-sampling comprises means for up-sampling the filtered reduced resolution signal by an up-sampling factor to produce the up-sampled filtered signal, and wherein the up-sampling factor and the down-sampling factor are equal.

Claim 43: The apparatus of claim 42, wherein the means for performing linear filtering comprises means for performing linear filtering with a rectangular impulse response of length *dec* on the digital input signal to produce the filtered digital input signal, and wherein *dec* is equal to the down-sampling factor and to the up-sampling factor.

Claim 44: The apparatus of claim 43, wherein the means for performing low-pass linear filtering comprises means for performing low-pass linear filtering with a support of length *dec* on the up-sampled filtered signal to produce the digital output signal.

Claim 45: An apparatus for producing a second digital image from a first digital image, the first digital image including a luminance signal, a first chrominance signal, and a second chrominance signal, the second digital image including the luminance signal, a first filtered chrominance signal, and a second filtered chrominance signal, the apparatus comprising:

means for filtering the first chrominance signal of the first digital image according to the method of claim 1 to produce the first filtered chrominance signal; and

means for filtering the second chrominance signal of the first digital image according to the method of claim 1 to produce the second filtered chrominance signal.

Claim 46: The apparatus of claim 45, wherein the first digital image is encoded according to a first color space, and wherein the apparatus further comprises:

means for converting a third digital image encoded according to a second color space into the first digital image.

Claim 47: The apparatus of claim 46, wherein the means for converting comprises:

means for subtracting a green color signal of the third digital image from a red color signal of the third digital image to produce the first chrominance signal;

means for subtracting the green color signal of the third digital image from a blue color signal of the third digital image to produce the second chrominance signal; and

means for providing the green color signal as the luminance signal.

Claim 48: The apparatus of claim 45, further comprising:

means for converting the second digital image into a fourth digital image encoded according to a third color space.

Claim 49: The apparatus of claim 48, wherein the means for converting comprises:

means for adding the first filtered chrominance signal to the luminance signal of the second digital image to produce a red color signal of the fourth digital image;

means for adding the second filtered chrominance signal to the luminance signal of the second digital image to produce a blue color signal of the fourth digital image; and

means for providing the luminance signal of the second digital image as a green color signal of the fourth digital image.

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Registration No. 25,173

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL
For FY 2005

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT	($)	500.00

Complete if Known	
Application Number	09/628,629
Filing Date	July 31, 2000
First Named Inventor	Suhail S. Saquib
Examiner Name	A. P. Bhatnagar
Art Unit	2623
Attorney Docket No.	8445

METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☑ Deposit Account Deposit Account Number: 16-2195 Deposit Account Name: Polaroid Corporation

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☑ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☑ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17 ☑ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES Fee ($)	FILING FEES Small Entity Fee ($)	SEARCH FEES Fee ($)	SEARCH FEES Small Entity Fee ($)	EXAMINATION FEES Fee ($)	EXAMINATION FEES Small Entity Fee ($)	Fees Paid ($)
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims _____ - 20 or HP = _____ x _____ = _____ Extra Claims / Fee ($) / Fee Paid ($)

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims _____ - 3 or HP = _____ x _____ = _____ Extra Claims / Fee ($) / Fee Paid ($)

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims Fee ($) _____ Fee Paid ($) _____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets _____ - 100 = _____ Extra Sheets / 50 = _____ Number of each additional 50 or fraction thereof (round up to a whole number) x Fee ($) _____ = Fee Paid ($) _____

4. OTHER FEE(S)

	Fees Paid ($)
Non-English Specification, $130 fee (no small entity discount)	
Other (e.g., late filing surcharge): Filing a brief in support of an appeal	500.00

SUBMITTED BY

Signature		Registration No. (Attorney/Agent) 25,173	Telephone 781-386-6405
Name (Print/Type)	Gaetano D. Maccarone		Date January 14, 2005